CLAIMS

What is claimed is:

1. A method for positioning individual receiver elements of an arrangement, wherein the arrangement includes at least two receiver elements providing at least two inputs to a signal processing system, comprising:

identifying at least one location of a source of at least one signal of interest;

determining a position for at least one first receiver element;

generating a set of criteria in response to characteristics of the at least one signal of interest, wherein the set of criteria provide satisfactory performance of the signal processing system; and

determining a position of at least one additional receiver element relative to the at least one first receiver element in response to the set of criteria.

2. The method of claim 1, wherein the set of criteria includes disqualification of receiver element placements that lead to identical signals being registered by more than a specified number of the individual receiver elements.

3. The method of claim 1, wherein the signal processing system distinguishes among the at least one signal of interest and at least one interfering signal using at least one input signal registered by the at least two receiver elements.

4. The method of claim 3, wherein the set of criteria includes positioning the individual receiver elements so that a sum of interfering signals that are registered by the at least two receiver elements have similar characteristics.

5. The method of claim 3, wherein the spacing between the at least two receiver elements is approximately in the range of 0.5 inches to 5 inches.

6. The method of claim 3, wherein the at least two receiver elements comprise at least two microphone elements.

7. The method of claim 6, wherein a primary axis of each of the at least two microphone elements is approximately perpendicular to a direction of sound wave propagation from the at least one signal of interest.

8. The method of claim 6, wherein a primary axis of each of the at least two microphone elements is approximately parallel to a direction of sound wave propagation from the at least one signal of interest.

9. The method of claim 6, wherein a primary axis of one of the at least two microphone elements is approximately perpendicular to a direction of sound wave propagation from the at least one signal of interest and a primary axis of another of the at least two microphone elements is approximately parallel to the direction of sound wave propagation from the at least one signal of interest.

10. The method of claim 1, wherein the individual receiver elements are coupled to at least one device selected from a group consisting of computers, monitors, hand-held computing devices, hearing aids, vehicle telematic systems, cellular telephones, personal digital assistants, and communication devices.

11. The method of claim 1, wherein the individual receiver elements coupled to the vehicle telematic systems are located in at least one vehicle component selected from a group consisting of pillars, visors, headliners, overhead consoles, rearview mirrors, dashboards, and instrument clusters.

12. The method of claim 1, wherein the individual receiver elements are positioned on at least one item selected from a group consisting of pens, writing instruments, audio playback and recording devices, listening devices, headsets, earplugs, articles of clothing, eye glasses, hair accessories, watches, bracelets, earrings, jewelry, items that can be worn on a body, and items that can be worn on articles of clothing.

13. The method of claim 1, wherein the individual receiver elements are coupled to a device inserted in the ear canal.

14. A method for positioning a receiver array of a signal processing system, comprising:

identifying at least one location of sources of at least one signal of interest;

determining a position of at least one first receiver element of a receiver array relative to the at least one location, wherein the at least one first receiver element receives the at least one signal of interest first in time; and

determining a position of at least one second receiver element of the receiver array relative to the at least one first receiver element, wherein the at least one second receiver element receives the at least one signal of interest second in time,

wherein a spacing between the at least one first and second receiver elements provides at least one time delay that supports generation of a plurality of linear combinations of the at least one signal of interest and a sum of interfering sources, and registration of a sum of interfering sources so that a first sum resembles a second sum.

15. The method of claim 14, wherein the spacing supports performing signal extraction on a plurality of delayed versions of at least one received signal.

16. The method of claim 14, wherein the at least one first receiver element comprises at least one first microphone and the at least one second receiver element comprises at least one second microphone.

17. The method of claim 16, further comprising isolating the at least one signal of interest using at least one inter-microphone differential in signal amplitude in each of the at least one first microphone and the at least one second microphone.

18. The method of claim 14, further comprising at least one first receiver element and at least one second receiver element corresponding to each of a plurality of sources.

19. The method of claim 14, further comprising at least one first receiver element corresponding to each of a plurality of sources, wherein the at least one second receiver element comprises one microphone element common to the plurality of sources.

20. The method of claim 14, wherein the at least one first receiver element receives at least one signal from a first source first in time and at least one signal from a second source second in time, wherein the at least one second receiver element receives the at least one signal from a second source first in time and the at least one signal from a first source second in time.

21. A method for extracting at least one signal of interest from a composite audio signal, comprising:

identifying at least one location of a source of at least one signal of interest;

determining a position for at least one first microphone element of a microphone arrangement relative to the at least one location;

generating a set of criteria in response to characteristics of the composite audio signal, wherein the set of criteria provide for satisfactory extraction of the signal of interest from the composite audio signal; and

determining a position of at least one additional microphone element of the microphone arrangement relative to the at least one first microphone element in response to the set of criteria.

22. The method of claim 21, wherein the set of criteria are replaced by a second set of criteria, wherein the second set of criteria provide for satisfactory removal of the signal of interest from the composite audio signal.

23. The method of claim 22, wherein the set of criteria are supplemented by the second set of criteria.

24. The method of claim 21, wherein the set of criteria include maintaining causality during signal extraction.

25. The method of claim 24, further comprising maintaining causality by delaying at least one input signal registered by at least one microphone element of the microphone arrangement.

26. A method for extracting at least one signal of interest from a composite audio signal, comprising:

determining a position of at least one first receiver element of a receiver array relative to at least one location of a source of the at least one signal of interest, wherein the at least one first receiver element receives the at least one signal of interest first in time;

determining a position of at least one second receiver element of the receiver array relative to the at least one first receiver element, wherein the at least one second receiver element receives the at least one signal of interest second in time, wherein a spacing between the at least one first and second receiver elements allows for generation of a plurality of linear combinations of the at least one source signal and a sum of interfering sources, and registration of a sum of interfering sources so that a first sum resembles a second sum;

receiving the composite audio signal using the receiver array; and

extracting the at least one signal of interest using at least one inter-receiver element differential in signal amplitude.

27. The method of claim 26, wherein the spacing supports performing signal extraction on a plurality of delayed versions of at least one received signal.

28. The method of claim 26, further comprising at least one first receiver element corresponding to each of a plurality of sources, wherein the at least one second receiver element comprises one microphone element common to the plurality of sources.

29. A microphone array for use with speech processing systems, comprising:

at least one first microphone element positioned to receive at least one signal of interest first in time from at least one source;

at least one second microphone element positioned to receive the at least one signal of interest second in time relative to the at least one first microphone element, wherein a spacing between the at least one first and second microphone elements allows for generation of a plurality of combinations of the at least one source signal and a sum of interfering sources.

30. The microphone array of claim 29, wherein the spacing supports registration of a sum of interfering sources so that the sum registered by at least one microphone element resembles the sum registered by at least one other microphone element.

31. The microphone array of claim 29, wherein at least two microphone elements receive the at least one signal of interest at unknown times, wherein a delay is introduced to at least one received microphone signal prior to signal processing.

32. The microphone array of claim 31, wherein a delay of a first length is applied to a received signal of a first microphone element and a delay of a second length is applied to a received signal of a second microphone element.

33. The microphone array of claim 29, wherein the spacing is approximately in the range of 0.5 inches to 5 inches.

34. The microphone array of claim 29, further comprising at least one first microphone element and at least one second microphone element each corresponding to one of a set of signal sources of interest.

35. The microphone array of claim 29, further comprising at least one pair of microphone elements, wherein each pair of microphone elements corresponds to at least one signal source of interest.

36. The microphone array of claim 29, wherein at least one microphone element is common to at least two microphone pairs.

37. The microphone array of claim 29, further comprising at least one first microphone element corresponding to each of a plurality of sources, wherein the at least one second microphone element comprises one microphone element common to the plurality of sources.

38. The microphone array of claim 29, wherein the microphone array is coupled to at least one device selected from a group consisting of hand-held computing

devices, hearing aids, vehicle telematic systems, cellular telephones, personal digital assistants, and communication devices.

39. The microphone array of claim 38, wherein the microphone array coupled to a vehicle telematic system is located in at least one vehicle component selected from a group consisting of pillars, visors, headliners, overhead consoles, rearview mirrors, dashboards, and instrument clusters.

40. The method of claim 29, wherein the microphone array is positioned on at least one item selected from a group consisting of pens, writing instruments, audio playback and recording devices, listening devices, headsets, earplugs, articles of clothing, eye glasses, hair accessories, watches, bracelets, earrings, jewelry, items that can be worn on a body, and items that can be worn on articles of clothing.

41. An audio signal processing system comprising:

at least one signal processor;

at least one microphone array coupled among at least one environment and the at least one signal processor, wherein the at least one signal processor extracts at least one signal of interest from a composite audio signal.

42. An audio signal processing system comprising:

at least one signal processor;

at least one microphone array coupled among at least one environment and the at least one signal processor, wherein the at least one microphone array comprises:

at least one first microphone element positioned to receive at least one signal of interest first in time from at least one source in the at least one environment;

at least one second microphone element positioned to receive the at least one signal of interest second in time relative to the at least one first microphone element, wherein a spacing between the at least one first and second microphone elements allows for generation of a plurality of linear combinations of the at least one source signal and a sum of interfering sources, and registration of a sum of interfering sources so that a first sum resembles a second sum.

43. A method for extracting at least one signal of interest from a composite audio signal using at least two microphone elements each corresponding to an input channel, comprising allocating contents of at least one input channel among at least two output channels, wherein at least one output channel of the at least two output channels includes a higher proportion of the at least one signal of interest than the at least one input channel.

44. The method of claim 43, wherein the at least one output channel contains a lower proportion of the at least one signal of interest than the at least one input channel.

45. The method of claim 43, wherein allocating includes at least one blind signal separation method.

46. The method of claim 43, wherein a number of input channels used varies in response to characteristics of the at least one input channel.

47. The method of claim 43, wherein a number of output channels used varies in response to characteristics of the at least one input channel or the at least one output channel.

48. The method of claim 43, wherein allocating includes at least one operation among at least one input channel and at least one other input channel.

49. The method of claim 43, wherein allocating includes at least one operation among a plurality of output channels.

50. The method of claim 43, wherein allocating includes at least one operation among the at least one input channel and the at least one output channel.

51. A computer readable medium including executable instructions which, when executed in a processing system, provides positioning information for a receiver arrangement of a signal processing system, the positioning information comprising:

identifying at least one location of a source of at least one signal of interest;

determining a position for at least one first receiver element;

generating a set of criteria in response to characteristics of the at least one signal of interest, wherein the set of criteria provide satisfactory performance of the signal processing system; and

determining a position of at least one additional receiver element relative to the at least one first receiver element in response to the set of criteria.

52. A computer readable medium including executable instructions which, when executed in a processing system, provides positioning information for a receiver array of a signal processing system, the positioning information comprising:

identifying at least one location of sources of at least one signal of interest;

determining a position of at least one first receiver element of a receiver array relative to the at least one location, wherein the at least one first receiver element receives the at least one signal of interest first in time; and

determining a position of at least one second receiver element of the receiver array relative to the at least one first receiver element, wherein the at least one second receiver element receives the at least one signal of interest second in time, wherein a spacing between the at least one first and second receiver elements provides at least one time delay that supports generation of a plurality of linear combinations of the at least one signal of interest and a sum of interfering sources, and registration of a sum of interfering sources so that a first sum resembles a second sum.

53. A computer readable medium including executable instructions which, when executed in a processing system, isolates at least one signal of interest from a composite audio signal, the isolation comprising:

determining a position of at least one first receiver element of a receiver array relative to at least one location of a source of the at least one signal of interest,

wherein the at least one first receiver element receives the at least one signal of interest first in time;

determining a position of at least one second receiver element of the receiver array relative to the at least one first receiver element, wherein the at least one second receiver element receives the at least one signal of interest second in time, wherein a spacing between the at least one first and second receiver elements allows for generation of a plurality of linear combinations of the at least one source signal and a sum of interfering sources, and registration of a sum of interfering sources so that a first sum resembles a second sum;

receiving the composite audio signal using the receiver array; and

isolating the at least one signal of interest using at least one inter-receiver element differential in signal amplitude.

54. A computer readable medium including executable instructions which, when executed in a processing system, isolates at least one signal of interest from a composite audio signal, the isolation comprising:

coupling at least two microphone elements to at least one input channel; and

allocating contents of the at least one input channel among at least two output channels, wherein at least one output channel includes a higher proportion of the at least one signal of interest than the at least one input channel.

55. The computer readable medium of claim 54, wherein the at least one output channel includes a lower proportion of the at least one signal of interest than the at least one input channel.

56. The computer readable medium of claim 54, further comprising determining an approximate position of at least one location of a source of the at least one signal of interest relative to at least one microphone element of a microphone arrangement.

57. An electromagnetic medium including executable instructions which, when executed in a processing system, provides positioning information for a receiver arrangement of a signal processing system, the positioning information comprising:

identifying at least one location of a source of at least one signal of interest;

determining a position for at least one first receiver element;

generating a set of criteria in response to characteristics of the at least one signal of interest, wherein the set of criteria provide satisfactory performance of the signal processing system; and

determining a position of at least one additional receiver element relative to the at least one first receiver element in response to the set of criteria.